WHY CHINESE PURCHASED GLASS FROM CHOLAS

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Introduction: Historians starting with K.A. Nilkakanta Sastri[1] have made casual and passing references that the Cholas' trade, export or tribute to the Chinese included glass, glassware and so on without pointing out the significance. Of course, he has taken the details from the translations of Friedrich Hirth and W.W. Rockhill, Berthold Laufer and others. Western scholars have recorded their sceptic views that the glass in the sheet[2] and blown form could not have been there in the east, particularly, as such processes were developed in Europe specifically by the Germans in the 11th century CE. However the availability of glass, not only in the form of beads, but also in other forms such as conical and flat bottomed bottles, mirrors, even lenses at different archaeological sites has raised many questions in the historical perspective. The mention of Indian merchants specifically offering glass to the Chinese as tribute or for sale also provokes researcher to investigate about its significance. Thus, this paper critically analyses and studies about the glass in which the Chinese were interested.

The trade between India and China: The land and sea – route trade

between China and India had been age – old as each country tried to push off goods to the other during the medieval period. However, as the countries, particularly, European ones were competing with each other to procure goods of these two countries and develop further, they too involved in such commercial struggles and trade wars. The piracy killed the Indian maritime and trade activities, as the Indians never practiced such art. In the case of China, it surveyed the Indian requirements and manufactured goods accordingly and provided. In many cases, the Indian goods were further developed, manipulated and custom – made. Thus, glass and glassware were purchased from India and supplied ceramic ware in turn. Later after learning the expertise of the glass and glassware, China started supplying such goods. However, during the Chola period, the domination of Chola goods could be noted. But the Chinese annals of 5th – 7th centuries dubbed[3] all the products of India and Ceylon with others from Africa as "products of Persia" ! Thus, these types of claims have to be scrutinised carefully to find out the origin and manufacturing techniques of glass and glassware, as the Chinese accounts give different versions about it.

Indian origin of Chinese glass: Historians though write about the origin of glass in China differently, Friedrich Hirth (1845-1927) gives the following details[4]:

"According to the pei–shih it was during the time of T'ai –wu of the northern Wei dynasty (A.D.424 – 452) that traders came to the capital of Wei from the country of Ta – yiieh – chih, bordering on the north – west of India who said that, by fusing certain minerals, they could make all colours of liu –li. They then gathered and digged in the hills, and fused the minerals at the capital (near the present Ta-t'ung – fu in shan- his). When ready, the material so obtained was of even greater brilliancy than the liu –li imported from the west. The pei - shih specially states that, after this event, articles made of glass became considerably cheaper in China than they had been before. Grosier (Description de la Chine, edition of 1787, Vol. II, p.464)quotes the 'grandes annales' (meaning, I presume, the Sung – shu), according to which <<le Roi de Ta–tsin envoya a l'Empereur Tai – tsou, des pre'sents tres consid'erables en verres de toutes les couleurs, et quelques ann'ees apre's, un verrier qui avait l'art de changer au feu des cailloux en cristal, et qui en apprit le secret a des disciples; ce qui acquit beaucoup de gloire a ceux qui 'etaient venus et qui viennent de l' Occident>>. T'ai –tsu was the name commonly used in the earlier Sung annals for the Emperor W'en–ti of the Sung (A.D. 424 to 454), the contemporary and rival of T'ai–wu, under whose reign the art of making glass was said to have, therefore, to deal with a two–fold tradition as regards the introduction of glass–making in China, each of the two rival dynasties (Sung and Wei) claiming to itself the honour of having introduced the art. We are thus, it is true, left in doubts as to whether Syrian or Indian artisans helped to establish the first factory; but the very discrepancy existing in the tradition as regards the origin, strengthens my belief in the correctness of the date, of its introduction, as the reign of the two monarchs referred to fell within very nearly the same period, dating from A.D.424".

Thus, the following facts can be noted:

1. Indian traders of the silk–route (north – west of India bordering China) had been Manufacturer of glass and glassware, just metal manufacturers putting up furnace, pouring molten in the moulds and producing required goods. 2. Even today, the so –called nomadic come to doorsteps, obtain metal waste and convert it into metal icons of one's choice charging for conversion, thus naturally, the price of the icon gets reduced by the metal cost. 3.They could identify minerals and salts available locally, so that they could be added to the melt in proportions to produce different colours and qualities of glass. 4.After the absorption indigenization and development of glass making came down resulting in huge profits. 5. The rivalry among the Chinese dynasties in getting such profits naturally tried to suppress the secrets of glassmaking attributing to different source or silently declaring them as their own. 6. The Indian traders cum manufacturers might have been absorbed in Chinese society[6].

Opaque and transparent glass manufactured in the Chola country:

Chau Ju–kua, a Chinese traveler mentions opaque glass, transparent glass..... as goods manufactured by the Cholas among the other. He says transparent glass (Po'li) as the Coromandel Coast (Chulien = Chola) and Si – lan (Ceylon). Chau Ju – Kua mentions about glass screens used by the Ceylonese king. He describes like this[8]: *"At the foot of these trees are golden thrones with opaque glass screens. When the king holds his court he uses the eastern palace in the forenoon and the western in the afternoon. When (the king) is seated, the jewels flashing in the sunshine, the glass (screens) and jewel – tree shining on each other, make it like the glory of the rising sun".* From the Ceylon large mirrors were brought used for decorative purposes, made into sheets and lenses. Here, M.G. Dikshit[9] interpreted that Chau's reference to opaque and transport glass from the Chola country, probably refers to the opaque Indian red beads which are frequently found on the east coast, the chief centres being around Arikamedu and Rakha Mines in Bihar. He clearly missed the point that *"large mirrors were brought used for decorative purpose, made into sheets and lenses",* as the significance in the maritime and navigational context, it could be interpreted differently. As the Chinese work[10] under the Chola dominion, "..the native products comprised.....transparent glass,.....opaque glass..... ", separately, they have to be considered accordingly. Therefore, it was said that large mirrors were used for decorative purposes.

The Cholas' glass remnants at Tabuka river area: As the Chola sculptural presence was felt at Quanzhou, the glassmaking remnants have also been found in the South East Asian area. The Tanjore inscriptions specifically mention a kingdom of Madamalingam, which could be identified with Tambralinga near to the Kra isthamus linking Thailand and Malaysia, an important centre of maritime trade route linking Takupa to the Bay of Bandon. Not only Indian/ Hindu images dating from the 4th century CE have been found here, but also two Chola period images discovered at Vieng Sra and a Surya image of the Chola style at Jaiya. A profusion of pottery and glass remains were discovered at Ko Kao island, situated at the mouth of the Takupa river. Many of the glass remnants were from

China, while some may possibly have been of West Asia and Indian origin[11]. Thus, the spread of glass technology to SEA also should be taken into consideration.

A Mirror from western India[12]: Berthold Laufer (1847 – 1934), an anthropologist, who studied the ancient glass goods of China and India, recorded about a curious "Mirror" brought from India and offered for sale[13]. He noted that, "The story connected in this report with the crystal mirror is a somewhat abrupt and incomplete version of the well – known legend of the Diamond Valley, the oldest hitherto accessible Western version of which is contained in the writings of Epiphanius, Bishop of Constantia in Cyprus (circa 315 – 403)". In the story, the details given about mirror are as follows: " *A large junk of Fu – nan which had hailed from western India arrived (in China) and offered for sale a mirror of a peculiar variety of rock – crystal[14], one foot and four inches across its surface, and forty catties in weight. It was pure white and transparent on the surface and in the interior, and displayed many – coloured things on its obverse. When held against the light and examined, its substance was not discernible[15]. On inquiry for the price, it was given at a million strings of copper coins....."... The important points to be noted are:*

Therefore, the Chinese recording proves that they wanted to know more about the manufacturing details, the material with which it was manufactured, the composition of the coating etc. However, the doubt expressed was whether such technology could have existed in India at that time. Thus, Laufer came to the conclusion that it cannot be glass, for-

(1) The story of the Diamond valley makes it is matter of precious stones, as also the high price; (2) Real glass mirrors were not yet invented in the West and could not have been known in India

and Fu–nan in the sixth century. They did not come up in Europe before the latter half of the

13th century.

That it could not have been a diamond as has already been pointed out and the second objection that it could not been existing in the east before west is only expressing improbability rather than impossibility. Recent (2003/ 2006) studies show the possibility of existence of developed technology in different areas. Jay M.Enoch[16], an ophthalmologist has pointed out that *"In 2003, at the Brooklyn Museum in New York city, a major exhibit titled Art and Interconnections showed fine mirrors and lenses in eyes of an ibis statue. It revealed remarkable ties between art objects found in Egypt and regions extending eastward to Western India and north and westward". In fact, in his earlier paper, he did not mention about India[17]. Coming to the context, the procurement of mirror was from the "western India" and the period was from 4th to 12th centuries and thus, the material period had been during the reign of the Cholas. Therefore, the probabilities have to be analyzed to find out the possibility.*

Lenses and "wine flasks" in India: In the excavations of IVC (c.2500 BCE) and Taxila(c.350 BCE), lenses have been found[18]. The Indian origin of Chinese glass during the 5th century has already been pointed out above. Thereafter, with a gap of about 700 years, suddenly Chinese

Description	Comment by the author
1. One foot and four inches across its surface, and forty catties in weight.	*Thus, the mirror of dimensions 12" x 4" inches could not have been a diamond or precious stone.*
2. It was pure white and transparent on the surface and in the interior, and	*That the interior was pure and transparent shows that it was observed from the side, indicating the thickness of the mirror, which should have been thin.*
3. Displayed many – coloured things on its obverse.	*This probably shows that the reverse was coated with mercury and as well as with decorated borders.*
4. When held against the light and examined, its substance was not discernible	*Shows that the buyer had been so anxious to know about the content of the substance with which it was manufactured.*

were buying glass from the Cholas for making lenses in 12th century[19] as per their own recordings. Then again lenses appeared during the Mughal period. The Jesuit interest in Indian science and technology and their collaboration with the European scientists have also been a notable factor. For example, Robert de Nobili (1577 – 1756) was discussing "Kepler Laws" with Indian astronomers at Madurai. With Antonio Rubino, he was searching for Indian astronomical instruments particularly astrolabe, telescope, crystals, salts, of course lenses20. Analyzing his activities, Vincent Cronin[21] notes that, "*through Rubino he also kept himself up to date about Galileo's startling discoveries, -no mean feat considering his isolated position and exacting work*", adding with surprise, "*The Indians possessed supplies of crystal but only a rudimentary knowledge of optics. Hence they had no eye – glasses (a lock Nobili was more than once able to fill and no telescope)*". He then proceeded to narrate about Nobili's discussion had with Indian's on Kepler's laws, distance between planets etc. comparing Indian works (Ulagathuva Sasthiram) with that of the Western[22]. Nobili collected many works on Indian crystallography, otherwise known as *Madhyama Kshara*[23]. Crystals and salts were exported to European countries during the 17th – 19th centuries under the guise of Salt petre.

Similarly, the conical and round – bottomed glass flasks[24], as any school students could identify, are mentioned as "amphora" found at Taxila and "wine flasks" during 16th century. And again, there were retorts found exactly like the ones that are used in laboratories, however, they are mentioned as "Kapadwanj Glass"[25] (Sprinklers and Smoking Pipes) in one place. Ironically, in another place[26] conical and round-bottom flasks are also mentioned as Kapadwanj Glass". Therefore, with glass flasks one should drink wine and

the lense are used as ornaments for encrustation[27], and the retorts should be used for smoking or sprinkling etc., then "science students" may have to go mad with the archaeologists and historians.

The burning glass / lenses of China and India: There has been interesting discussion about the glasses and lenses used by the ancient Chinese and Indians by Dr.Frank Brawley, Dr Emory Hill and other ophthalmologists, optometrists and eye–specialists. Incidentally, this has been the title of an important article[28] by Berthold Laufer discussing about the lenses used for producing fire. That lenses used for burning or producing fire were used proves the nature convex lenses used. In other words, glass made of required thickness or mould piece was ground to obtain such convex lenses to converge the light rays of Sun.

A scientific hypothesis denying the usage of lenses: Indian small beads fine jewellery and other minute sculptural details pose a question as to how the craftsmen or the manufactures could have produced such specimens without magnifying lenses. Here, also western scholars have put forward a hypothesis that such type of close work could have been done by a particular people with excellent close vision, namely nearsighted craftsmen or myopes. Leonard Gorelick and A.John Gwinnett[29] conclude that evidence could be produced for such alternative explanation from the scientific disciplines of ophthalmology, medical genetics, population genetics, and archaeology and art history as to how and why myopes could have done such work without the need for magnifying nature / size of the specimen, as according to the west, the general agreement has been that the lenses were invented only around 1250 CE. But the forceful conclusion arrived at cannot declare that all sculptors, jewel makers, precious metal workers, diamond cutters, polishers etc., must have been myopes only and such sweeping remarks appear to be unscientific. As the magnifying lenses doubles, triples and increases such expansion x times, no human being could have such capability to have such vision permanently or only at the time of working. Otherwise, different myope workers must have been used for executing the same work and that is highly improbable.

The reasons for the Chinese to purchase glass grom the Cholas:

Purchase of raw materials, certain inputs, ingredients, goods etc., by one person, society, nation or industry in general has different motives:

1. Just to know about it – constituents etc., so that to know how it is has been manufactured.

2. knowing it, tried to imitate to manufactured. 3. Improve, develop and manufacture further

4. After attaining such modified technology, exploit for commercialization.5. Produce in large numbers, so that when the price comes down, even the inventors might stop manufacturing it. 6. In other words, the dominant manufacturer could sump such goods at the doors of the original manufacturer or the inventor at competitive prices, so that he might stop his manufacture. 7. The lenses manufactured could have been used for invigational purposes, though, at present there are no evidences about the usage of telescopes

with the lenses. 8.Or the captions, navigators, sailors or any other maritime experts were having myopic vision, so that they could have seen distances to avoid telescope completely. 9. That the ships with cargo sailed over thousands of kilometers prove that the navigators must have used different sailing methods besides the trade – wind sailing, coastal navigation etc.,

Thus, the Chinese by their very nature could have purchased glass and glassware from the Indians / Cholas and then started manufacturing by themselves with improved versions satisfying the customers of different civilizations.

Circumstantial and corroborative evidences about the uasage of magnifying glasses: The Indus Valley people used minute drills of the order 0.1 mm onwards for drilling holes in crystal/ glass beads and as well as teeth. The diameters of the drills recovered had been 0.26 to 0.34 cm to drill beads[30]. According to a report in the April 6,2006 issue of *Nature* Italian researchers[31] working at cemetery site in the Neolithic town of Mehrgarh discovered drill holes on at least eleven molars from people buried MR^3 cemetery. Light microscopy showed the holes were conical, cylindrical or trapezoidal in shape. A few had concentric rings showing drill bit marks, and a few had some evidence for decay. No filling materials was noted, but tooth wear on the drill marks indicate that each of these individuals continued to live on after the drilling was completed[32].

About Susruta Samhita (c.800 BCE), Vincent Iraldi notes[33], "*More complete than earlier collection, in addition to identifying seventy – six eye conditions and prescribing various zoological, mineralogical, botanical, and nutritional treatments for conjunctivitis, cataract, trachoma, ametropia (abnormal eyes causing refractive errors), etc, this collection provided first known description of ocular anatomy and physiology*". Then he quotes from C.Fryer[34], "*Undoubtedly Susruta's greatest achievement, however, was his discovery of the crystalline lenses whose purpose he realized was to focus light rays on to the retina, and the invention of classical cataract surgery*". Then he raises the question 'could this be a hint of Kepler's retinal image theory, and explains that it is known that the Indian / Egyptian model eventually influenced Greek medicine through the writings of pytrhagorus (fl.C.530 BCE) and his followers. However, the erroneous Greek theory was overthrown by Kepler's retinal image demonstration at the beginning of seventeenth century.

Kepler's connection with India: It has already been pointed out that Robert de Nobili (1577 – 1656) was discussing about Johannes Kepler (1571 – 1630) with Indians and collaborating with his Jesuit friend Antonio Rubino was a student of Tycho Brahe (1566 – 1601) whose planetary model resembles that of Nilakanta Somasutvan (1444 – 1550) and hence, it has been suggested that the Indian model might have been adapted and adopted by the later[35]. Kepler studied the Kaliyuga and reckoning of the Hindus, but accused that Hindus borrowed from the Christians and the Jews from the Chaldeans, who, it is claimed that Messiah would appear in the Lunar year of the world 4320 contemporary of Christopher Clavius), expect that it involves eliptical orbits Tycho Brahe's student was Johannes kepler, who obtained his elliptical orbits by computing

his (Tycho's) observations. In 1990, it was pointed out that Kepler fabricated his data to obtain the planetary motion[36]. If the data could be obtained scientifically by working based on observations or derived formulae, one need not cook up figures, because, the figures are mathematical, which could be verified by any body to find out the facts contained. Therefore, scientist like Kepler could not have changed his figures, unless, he got hold of some other figures, which would have appealed to him the most. As he was having only the final figures and not working to arrive at such figures, he would have arrived at some figures without giving the source or working. Therefore, such changed figures are perhaps now mentioned as "fabricated". By all means, the source material was nothing but Indian, which was given to the scientists on a plater. Thus these evidences prove that the westerners borrowed Indian technology. modified and developed further according to circumstances.

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2. Indian palaces, forts and buildings contain glass sheets of different colours and thicknesses up to medieval period and thereafter. The coloured glasses were used in the multi-storeyed buildings for lighting purposes. The provision of glasses makes the interior with light during day time. After the advent of the Mughals, the pattern and design of manufacture were changed.
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4. Friedrich Hirth, *China and the Roman Orient*, ARES Publishers, Inc., Chicago, 1975 (from the reprint of the edition Shaghai & Hong Kong, 1885), pp.231-232.
5. According to the Wei-shu, quoted in the Yuan-chien-lei-han, ch.364,p.31, they came from India O.Cf.Pliny, l.c., 192."*Auctores sunt in India ex crystallo fracta fleri et ob id nullum* (sc.varum] *comparari Indico>>*.
6. The Europeans adopted and adapted the same techniques in kidnapping and converting the craftmen, weavers, laskars and others.
7. Friedrich Hirth and W.W.Rockhill, *opt.cit.*, p.96.
8. *Ibid*,pp.72-73.
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adopts Hie usual meaning 'glass' though he allows its connection with Sphotfka (Skt). It cannot be glass, for (1) the story of the Diamond valley makes it a matter of precious stones, as also the high price; (2) real glass mirrors

were not yet invented in the West and could not have been known in India and Fu-nan in the sixth centure. They did not come up in Europe before the latter half of the 13th century. In later times p'o-li did mean glass, Laufer (abridged).

15. Hirth's translation of this sentence is based on an incomplete text and renders it unintelligible. "As they were not acquainted with the complete text, as handed down in Tai ping yV lan, Hirth and Rockhill understand that Hie junks of Fu-nan habitually sell such mirriors to the Chinese. Our story renders it clear that only an isolated instence comes into question, and that this particular, unusual mirror could not even be disposed of in China. The Ltenp Jeuny too is not a work on commercial geography unnmarlsfag general date, but is a story-book narrating – specific events, We have in the present case not a description, but a narrative.
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